Design Patterns for Augmented Reality Learning Games

Felix Emmerich[1], Roland Klemke[1,2], Thomas Hummes[1]

[1]Mediadesign Hochschule, Faculty of Gamedesign, Düsseldorf, Germany

[2]Welten Institute – Research Centre for Learning, Teaching and Technology, Open University of the Netherlands, Heerlen, The Netherlands

GALA Conference, December 5-7, Lisbon, Portugal

AUGMENTED REALITY

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Image: https://www.flickr.com/photos/sophiap/7178122810/

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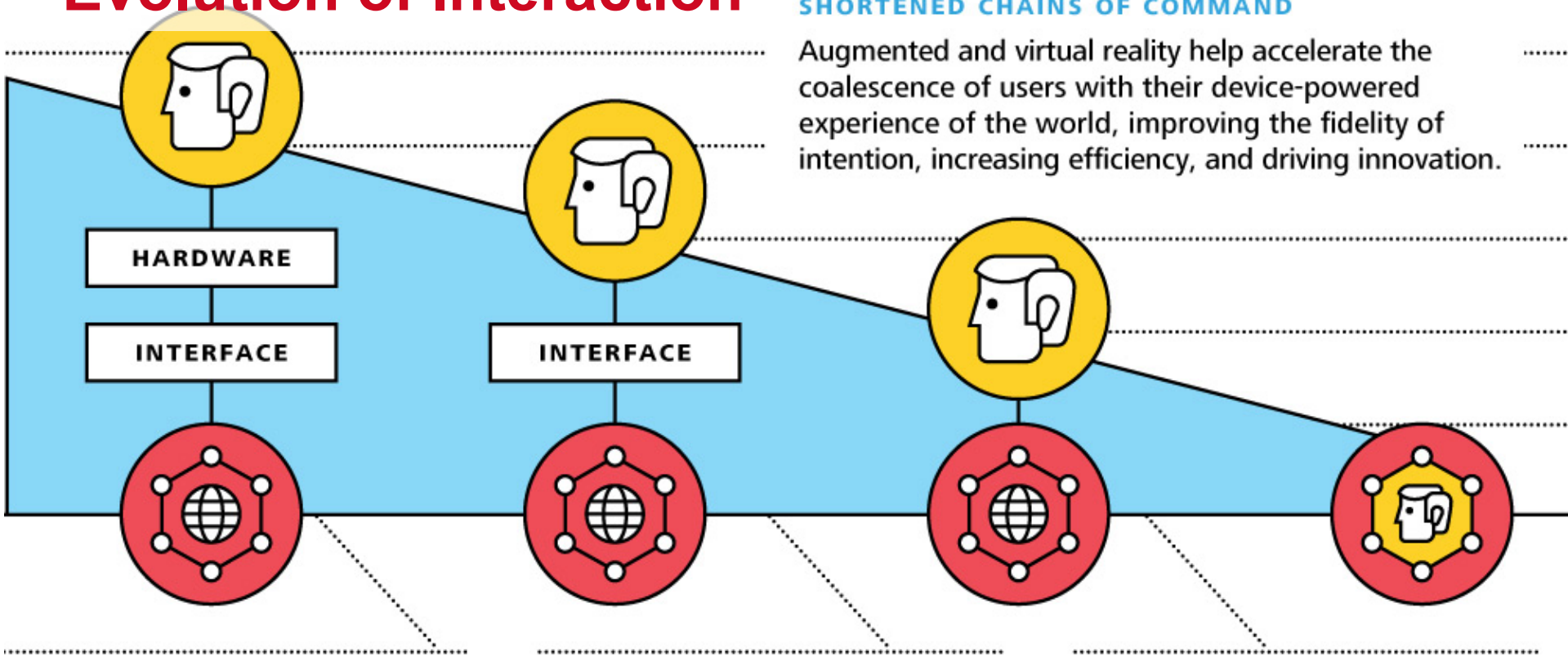
Augmented Reality with Wearables

Image: StatesChronicle, http://stateschronicle.com/wp-content/uploads/2015/01/hololens.jpg

Evolution of Interaction



SHORTENED CHAINS OF COMMAND

Augmented and virtual reality help accelerate the coalescence of users with their device-powered experience of the world, improving the fidelity of intention, increasing efficiency, and driving innovation.

MESSENGERS

Intermediate devices interact with interfaces; virtually all input occurs through a mouse or keyboard.

SMART SCREENS

Screens manipulated based on environment facilitate direct physical or spoken interaction with displays.

INTUITIVE INTERACTION

Devices respond to ambient cues and intentional movements to create empathetic, personalized experiences.

Graphic: Deloitte University Press | DUPress.com

AUGMENTED REALITY FOR LEARNING GAMES

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- Takes the world as playground
- Exploration and utilization of context
- Augmentation of reality
- What do we learn?

What is an augmented reality learning game?

Image: Phil Rogers,
http://www.flickr.com/photos/erase/5572308872/sizes/l/in/photostream/

A Pattern-Based Framework For AR Games

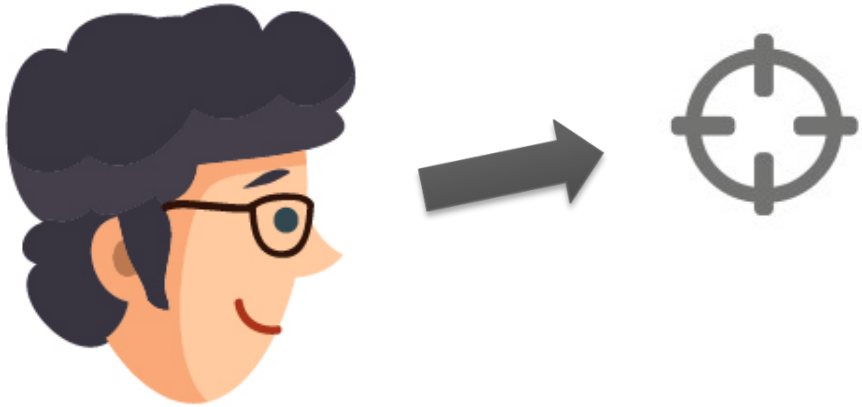
Category	Grouping of patterns by purpose
Pattern	A succinct name for the pattern
Forces/Problem	The issues the pattern is intended to combat
Feature/ Solution	A description of one way to solve the problem
Effects/ Consequences	The positive and negative consequences of applying the pattern, including design choices required for implementing the pattern
Requirements	We introduced requirements, which must or may be met to implement a pattern. This allows game designers interested in implementing patterns to ascertain whether a given pattern fits their criteria

(Björk & Holopainen, 2005), (Wetzel, 2013), (Antonaci et al, 2015)

1. Directional Patterns (Navigation & Orientation)

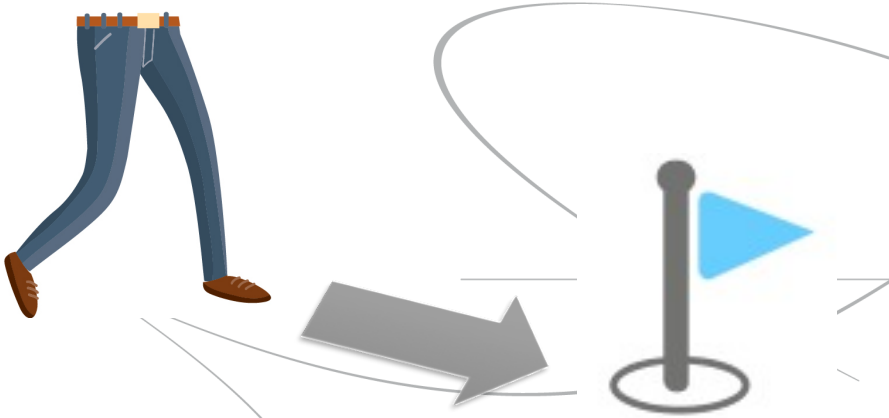
Directed Gaze

- Direct Attention
- Require location/ focus awareness



Directed Movement

- Direct user to location
- Require location/ focus awareness



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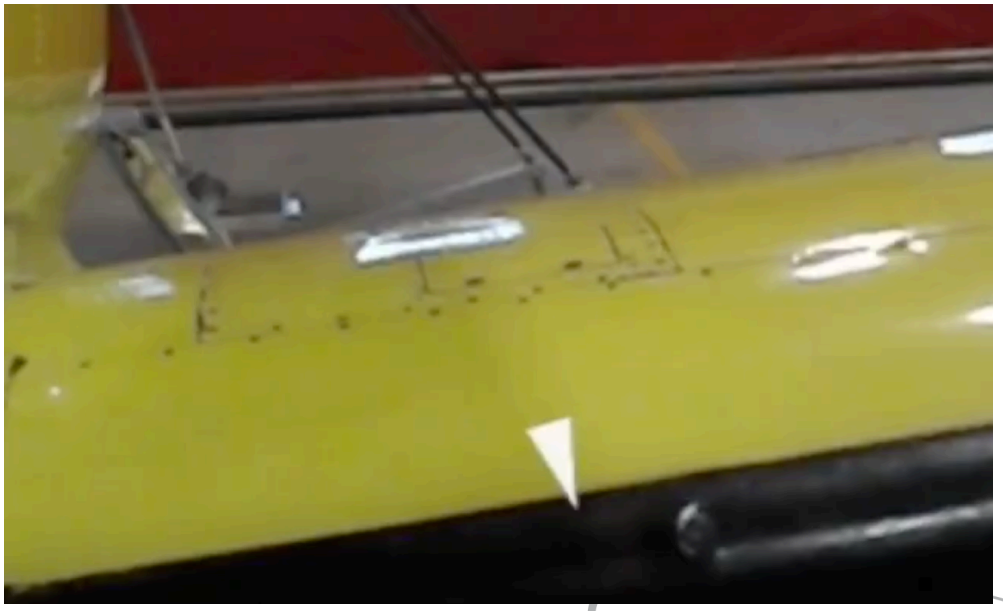
Icon sources: thenounproject.org, 0melapics, ibrandify, vectorpocket, / Freepik

1. Directional Patterns - Example

Directed Gaze

Point user to relevant elements outside the current field of vision



Images: WEKIT project http://wekit.eu/

2. Environmental Patterns

Environment-Adaptation

Interact with environment and adapt to it

Environment-Independence

Don‘t interact with environment

Environment Requirements

Check environmental conditions

Point of Interest (POI)

Provide location-based information

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2. Environmental Patterns - Example

Environment Requirements

Check room size, available space and usable surfaces prior to running a game

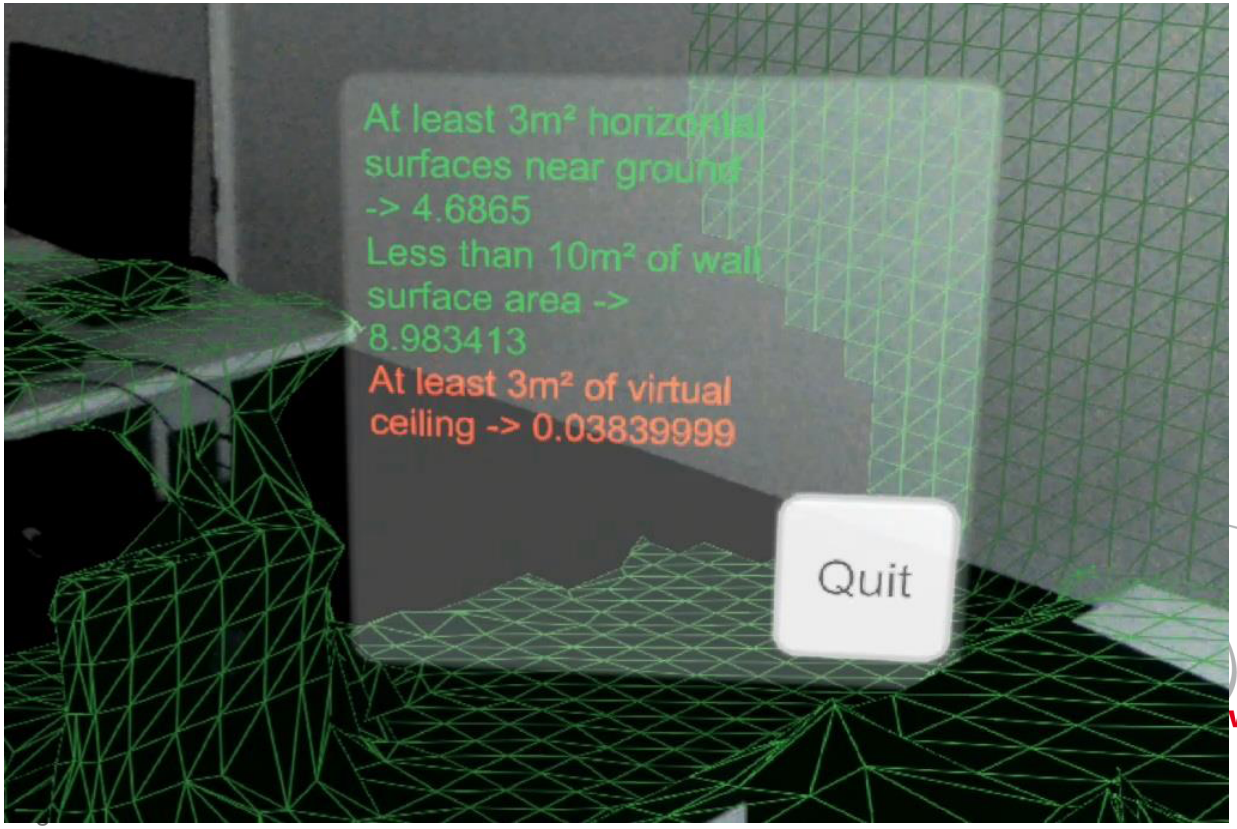

Image: Felix Emmerich

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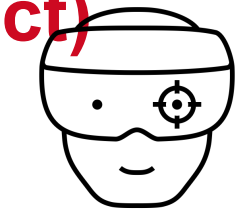
3. Input-related Patterns (Select & Interact)

Gaze Cursor

Show focus point
for object selection



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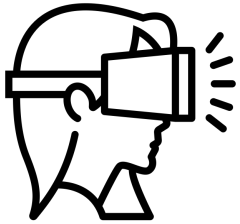
Gaze Point of Interest (Gaze POI)



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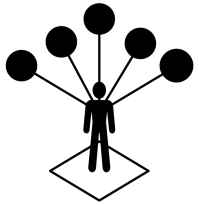

Created by Eunji Kang
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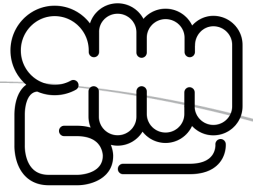
Highlight object
in gaze direction

Gesture-based Interaction

Interact with
highlighted object

Created by davidyu
from Noun Project



Created by davidyu
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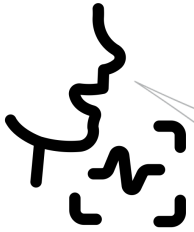
Voice Commands



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Allow for hands-free
interaction

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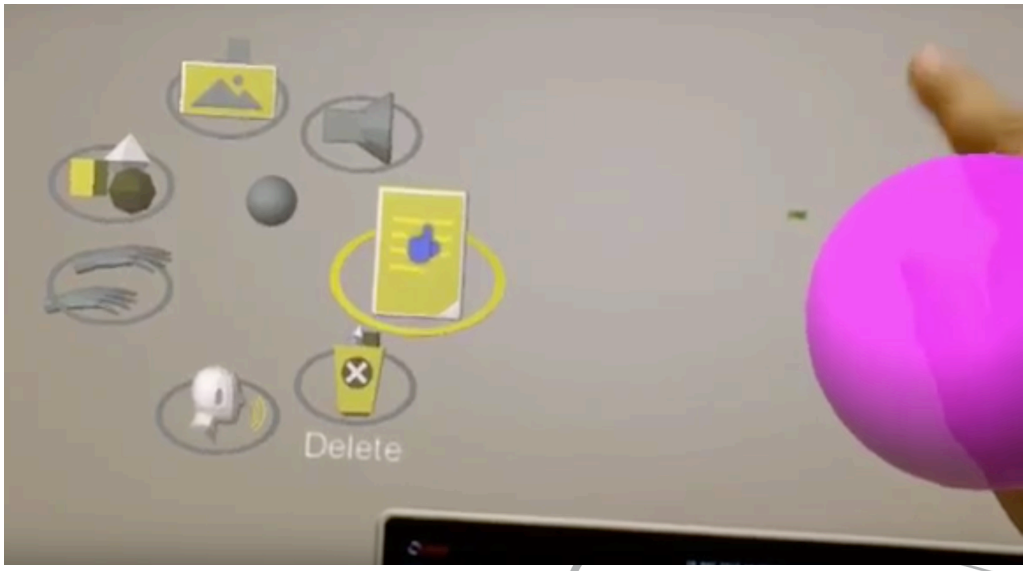
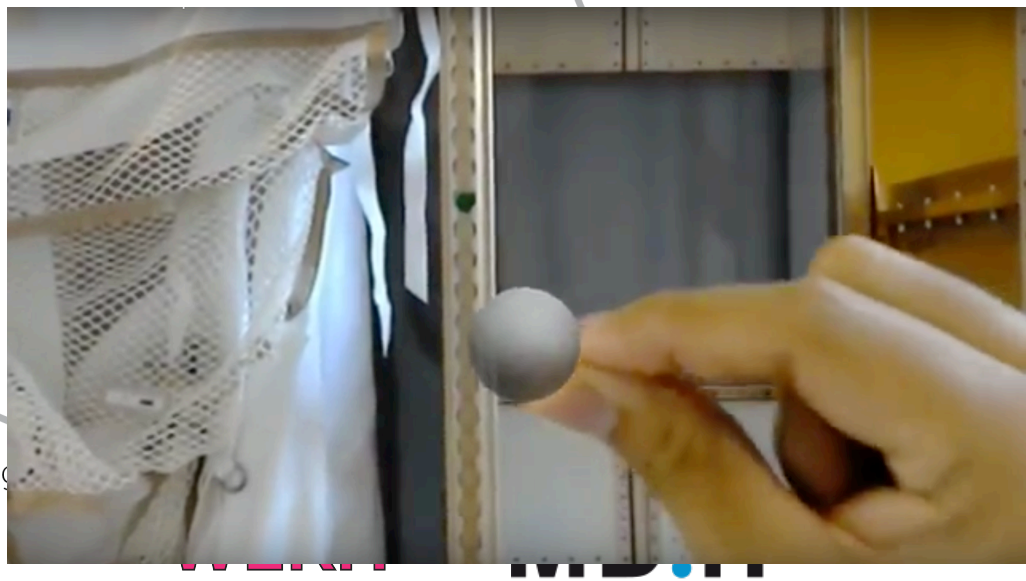
3. Input-related Patterns - Example

Gesture-based Interaction combined with Gaze Cursor

Select items from menu



Touching and moving objects

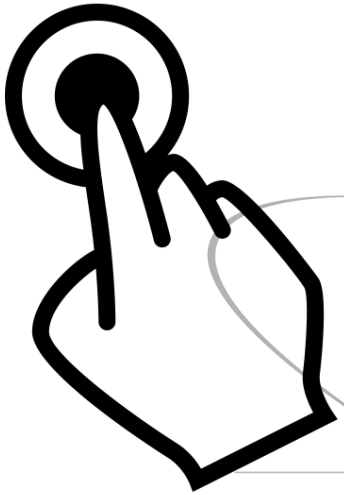


Images: WEKIT project http://wekit.eu/

4. Non-visual Patterns

Haptic Feedback

Use non-visual feedback channels when touching objects or entering areas



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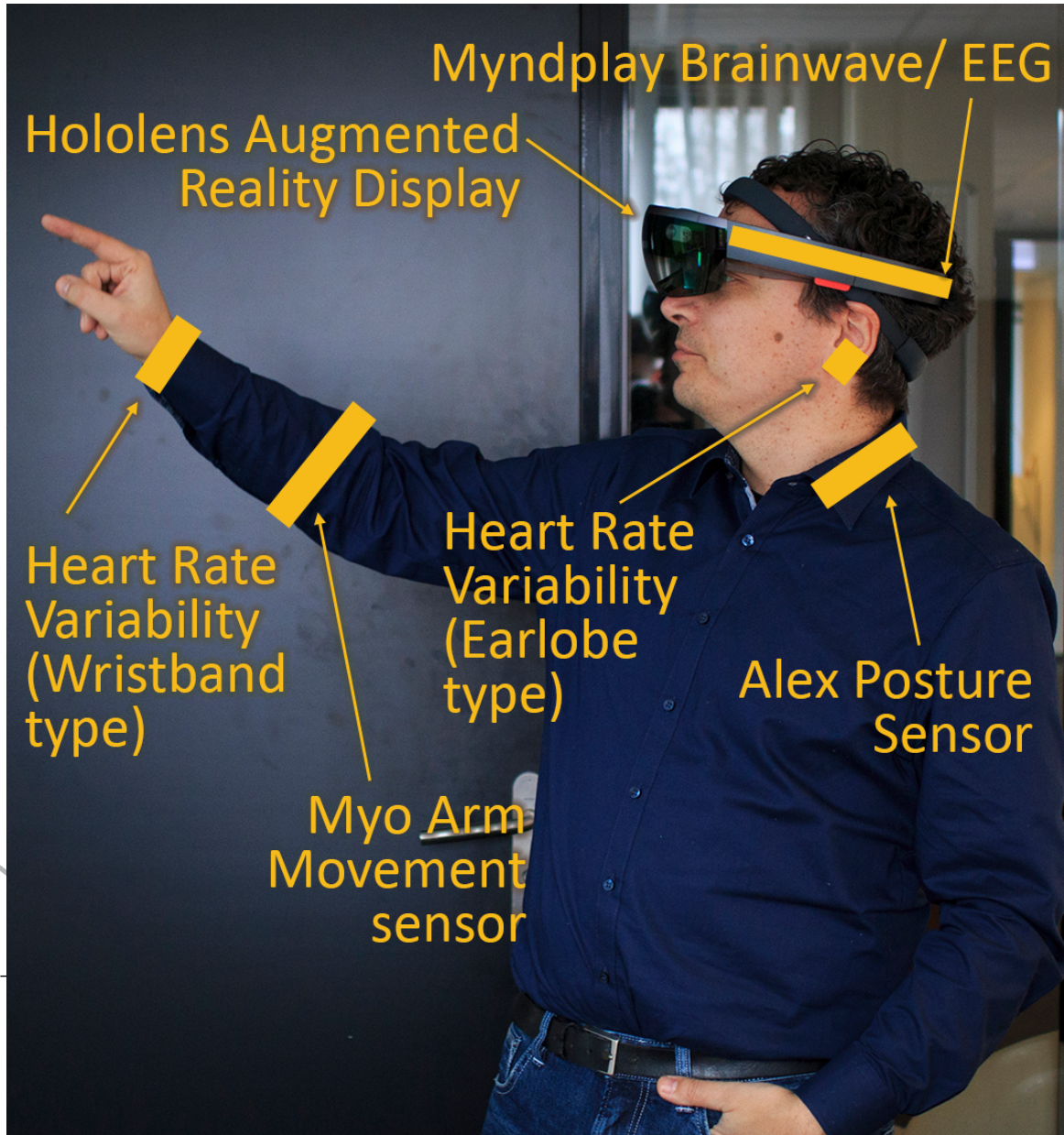
4. Non-visual Patterns - Example

Haptic Feedback

- Using additional sensors to capture position and posture
- Provide feedback with additional actuators



Images: WEKIT project http://wekit.eu/

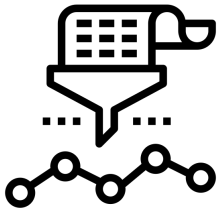
5. Media-related Patterns (playing, displaying, visualizing)

Auto-Play

Event-based
starting/stopping/pausing
of media elements

Created by Yo! Baba
from Noun Project

Information Filtering

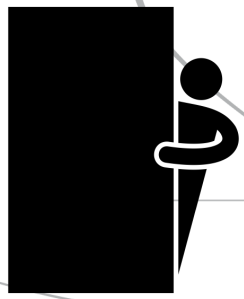


Created by Becris
from Noun Project

Avoid screen clutter
Filter by distance, angle, relevance

Obscured Information Visualization

Visualize hidden
objects or parts



Created by Andrew Doane
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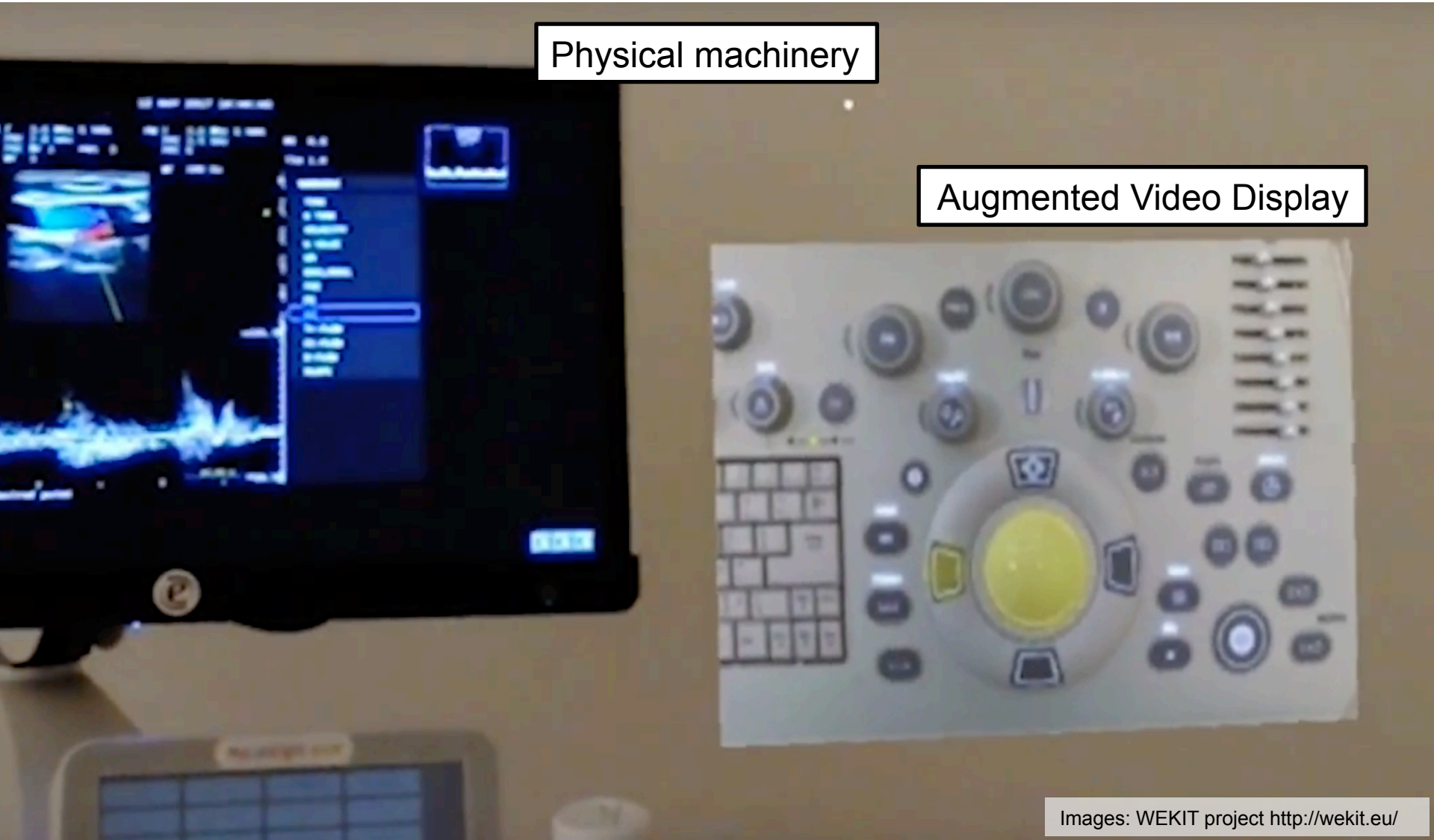
5. Media-related Patterns – Example

Auto-Play: location-based photo/video display



Images: WEKIT project http://wekit.eu/

6. Multi-user Patterns (sharing & communicating)

Shared Pointer

Support communication by
sharing gaze pointers
in real time

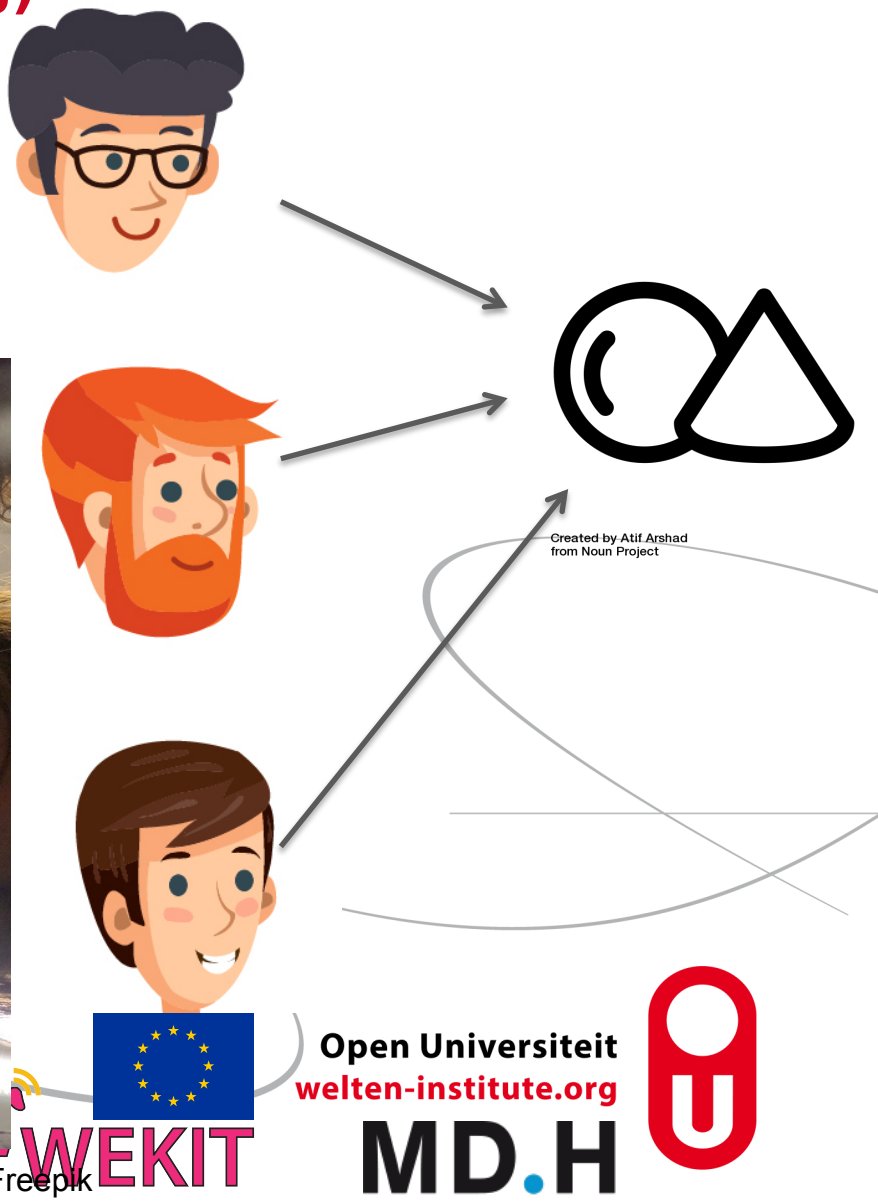


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Image: the WEKIT project, wekit.eu

COMBINED PATTERNS FOR AR LEARNING GAMES

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Extended Room

Virtual doors or windows enable to change the environment by passing through

Helpful in history or cultural learning: enable doors to the past or to other environments

Base patterns: Obscured information visualization, Environment requiremeents, Environment adaptation

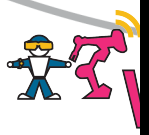
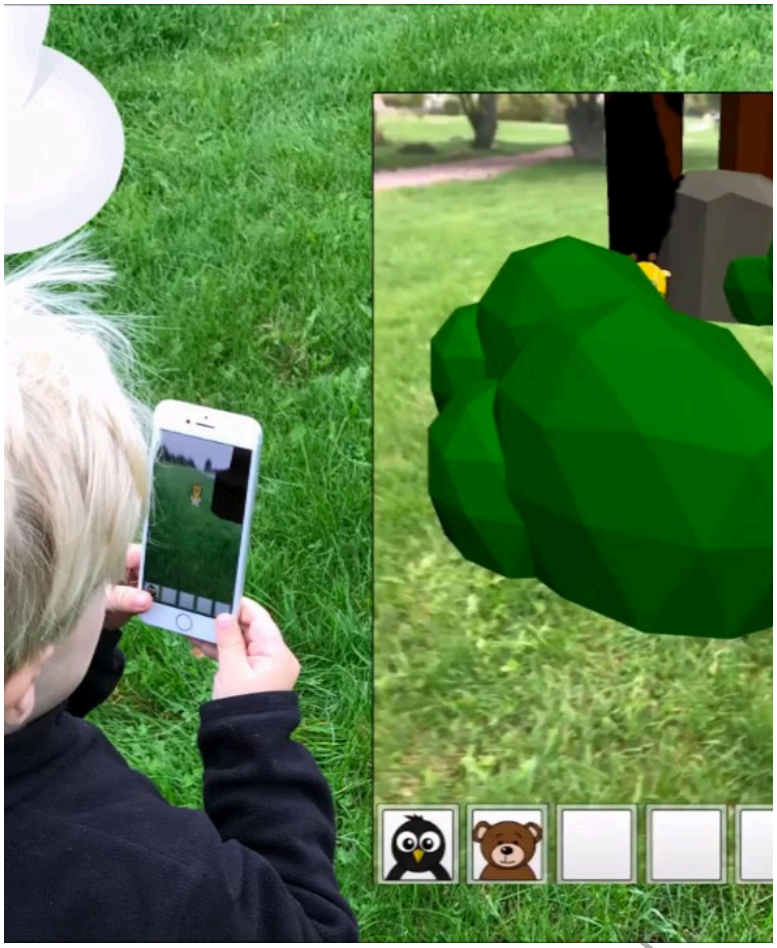


Image: https://www.youtube.com/watch?v=371ZQW_Yzck

Exploration & Search



Virtual objects should be hideable behind virtual / real structures

Explorative learning tasks

Base patterns: Obscured Information Visualization, Information Filtering, Environment Requirements, Environment Adaptation, Exploration, Clues

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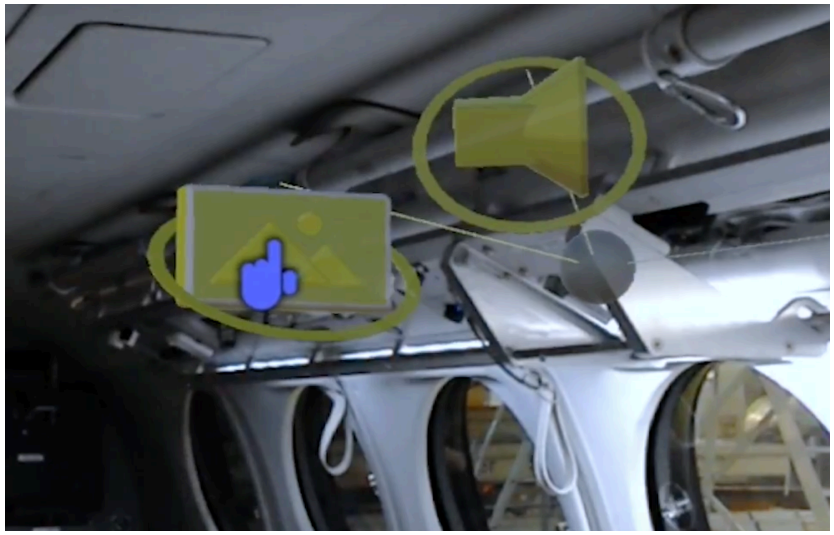
Image: https://www.youtube.com/watch?v=VhKJpIble0Q

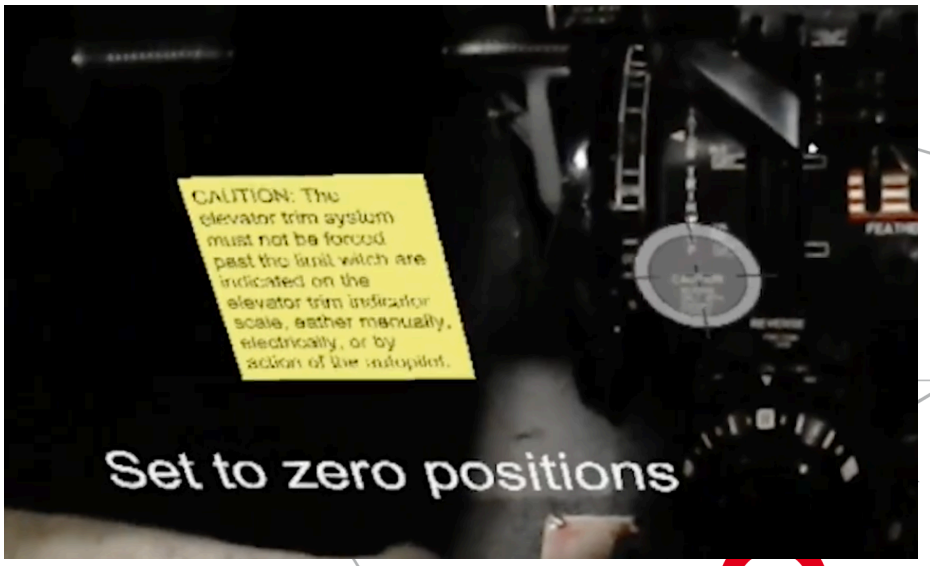
Asymmetric Multiplayer

Players share augmented model but play in different roles or with different information

Pattern can be applied to teacher / learner roles (authoring vs. instructional guidance vs. learning task)

Base patterns: Information Filtering, Shared Pointer, Asymmetric Information





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Images: WEKIT project http://wekit.eu/

Augmented Ghosttrack

Player can see and follow paths of other players

Learner can follow guided steps or improve on own previous recording

Base patterns: Shared Pointer, Information Filtering, Directed Gaze, Directed Movement

Images: WEKIT project http://wekit.eu/

X-Ray Vision

Visualize internal processes or mechanisms otherwise not visible

Explain hidden features

Base patterns: Obscured Information Visualization, Environment Adaptation and Gaze POI

Images: http://www.scottishconstructionnow.com/18894/consortium-visualises-augmented-reality-future-for-construction-industry/#

Conclusions: Application to Learning and Training - WEKIT use cases

WEKIT - Wearable Experiences for Knowledge Intensive Training

Evaluation in 3 Pilot cases under way:

- **Aircraft maintenance:** exploiting AR and WT for inspections, decisions making and safety
- **Healthcare:** exploiting AR and WT for improving responsibility in healthcare applications for medical imaging
- **Space:** exploiting AR and WT for astronauts training and assembly integration sub-systems

Images: WEKIT project http://wekit.eu/

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